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COAST BATTERIES

AND

THEIR SITES.

BY

CAPTAIN J. C. MATHESON, R.E.

CHATHAM:
PUBLISHED BY THE ROYAL ENGINEERS INSTITUTE.
PRINTED BY W. & J. MACKAY & CO., LIMITED.

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NOTE.

THE following notes include the principal part of the first portion of the Course upon Coast Defence at the School of Military Engineering. They do not give information as to the details of batteries, with which the remainder of the Course is concerned, as these details are continually changing, and are in part confidential; in addition to which they are really a matter of construction and do not affect the general intention of the Course, which is to give grounding in the principles upon which coast defences are based.

It must be understood, moreover, that these notes do not go further than their title implies, and that a coast defence scheme must include efficient means of lighting, communication, etc., etc., in addition to the actual batteries and their accessories.

I have to thank Colonel H. Barron, R.A., and Lieut.-Colonel L. C. Jackson, R.E., for their advice in the preparation of these notes.

J.C.M.

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COAST BATTERIES AND THEIR SITES.

It can hardly be questioned that the scheme of defence for the Empire must include some fortified harbours; without them the Navy is not free to carry out its work. Such harbours would be naval arsenals, commercial ports, or places chosen for their strategic value.

The most important part of the defences of these harbours is the batteries, and it is with them that these notes are principally concerned, with the conditions under which they have to be fought, and how these conditions affect their sites and general design.

Possible Forms of Attack.

The forms of attack to which a fortified harbour is exposed may be stated as follows :—

(1). *Raid, i.e.*, attack by small parties landed at night, who would try to destroy some definite object, such as a gun, a search light, position-finding station, etc. Such an attack can only be met by vigilant look-outs and patrols, and by making such objects difficult of access.

(2). *Torpedo-Boat Attack.*—This would be made with the object of destroying any ships in the port, or possibly of blowing in a dock gate.

(3). *Bombardment.*—This might be attempted with the idea of doing material damage or merely to create a moral effect; but, since only fortified harbours are being considered, bombardment could not be carried out without the ships coming into contact with the batteries. In any case, the results to be expected from mere bombardment of a port are extremely problematical, and the operation would involve a large expenditure of ammunition.

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(4). *Deliberate Engagement between Ships and Batteries.*—The object of this might be to try and destroy the batteries, in order either to do away with the value of the harbour or to prepare the way for, or to co-operate with, an attack on the place from the land. Such a form of attack does not seem at first sight probable, and is generally discounted by naval officers because of the danger to the ships. But in the past it has often been carried out, *e.g.*, Algiers Sebastopol, Lissa, Kagoshima, Alexandria, etc., and history is apt to repeat itself. In these attacks the great point to be noted is that they were generally carried out by the Power which had command of the sea and was thus more in a position to undertake the operation without fear of the possibly serious consequences of failure.

Such being the different forms of attack, it remains to be seen which are the most likely in the case of our own coast fortresses.*

(1). It is evident that all our fortified ports must take sufficient precautions to guard against the first form, namely, small raids.

(2). Defence against torpedo-boat attack depends to a large extent upon the geographical position of the port and on its importance. Very important harbours would be made practically secure against such an attack, whilst others of less importance would have to be content with a measure of protection; since, to be absolutely effective, a narrow entrance is necessary and also the use of booms. Ports which need only fear the attack of carried torpedo boats may be considered to require only the protection of their dock gates.

(3). Bombardment, or the indefinite attack by a few ships, which has been tried in the past and probably will be so again, in spite of the small results which generally ensue, is not much to be feared; but it is easy to provide the small amount of defences necessary to meet it.

(4). Our general defence policy is founded on the principle that we must retain the command of the sea, and from past history it is seen that deliberate actions between an enemy's fleet and our batteries are neither likely nor sound strategy so long as we do so. For this reason it may at first sight seem needless expense to provide for any of

* There is another naval operation which is of a similar nature to the attack on a fortified harbour, namely, the passage of a fleet through a fortified channel to get to clear water beyond. Examples of this are the Dardanelles, the Straits of Messina and Shimoneseki, and the case comes under the head of the attack on a fortified harbour with a long approach channel, which is considered later on.

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our ports sufficient defences to carry on a deliberate action against a large fleet. But on further consideration this will be seen to be hardly so, at all events in the case of our naval arsenals. They are absolutely essential to the carrying out of our general policy, the retention of sea-power, and must be rendered perfectly secure, and that without the aid of any ships close at hand. When the issues at stake are so great, we should always allow for the fact that an enemy may disregard ordinary principles. Then, again, coast batteries are very cheap and do not soon become obsolete, and their very existence may act as a deterrent and prevent an attack.* Finally, a temporary or local loss of command of the sea may expose our ports to deliberate attack. In the event of such an occurrence, strong coast defences may prove of great service in the damage which they could inflict upon an enemy's fleet. It must be remembered that it is a much more serious matter for a modern ship to get damaged than it was for an old wooden one. The latter took a great deal of punishment and could be easily and quickly repaired, very often by its own crew; this is far from being the case with the present ship, which must be repaired by skilled hands in a dockyard and may be rendered useless for a long time.

For these reasons it does seem wise that our naval arsenals, which are essential to the existence of the country, should be provided with sufficient defences to meet a powerful attack, even although one may be an unlikely contingency.

Method of Attack by Ships.

As regards the method of attack by ships on batteries, there is a certain amount of debate; but on the whole it seems fairly well agreed that if the ships really mean business they must come to close quarters as soon as possible, and so obtain full value of their probably greater volume of fire. A ship, at all events a large one, will almost certainly have more guns than a battery; for the reason that the ship, being movable, can make its guns useful anywhere, while the coast gun, being fixed, can only make itself felt over a few square miles; and, as many square miles have to be covered, economy of guns and men must be practised.

Also, at long ranges, the battery would form such a bad target that accurate practice against it would be impossible; the same,

* *E.g.*, Cronstadt in the Crimean War, and the German coast fortresses in the Franco-German War.

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however, does not apply to the ship, since that is always a prominent object, and there is far more vulnerable surface in the ship than in the battery.

At short ranges, not only would the practice be more accurate (of course on both sides), but every weapon on the ship, down to machine guns and even rifles, would be able to come into play, and the volume of fire would have every chance given it.

Short range actions in the past have always been more successful, so far as the ships were concerned, than those fought "at long bowls." At Porto Bello in 1739, at Hispaniola in 1748, and at Algiers in 1816 the ships which were so successful were at pistol range from the batteries. At Sebastopol the main or off-shore squadron did hardly any damage, while the smaller in-shore squadron produced a great effect on Fort Constantine. At Santiago, in the Spanish-American War, the effect of the American fire was trifling owing to the long ranges used, and the same was the case at San Juan.

It is fairly probable, then, that future actions will be fought at short ranges, and we may expect that the ships will endeavour to concentrate their fire upon particular batteries and, where possible, try to enfilade them from suitable positions.

In addition to considering the form of attack and the method in which it will be carried out, the nature of the ships themselves must be taken into account.

Battleships as Opponents.

It will be superfluous here to give detailed descriptions of modern vessels of war; their leading features in the way of armament and protection are too well known to require it, and the details are continually changing. All that need be done is to draw attention to certain points in their design which affect the question of a contest between them and coast batteries. Of these points the principal is the fact that ships are not designed to fight batteries, but other ships. They form well-defined upstanding targets on a flat plain, where no cover can be obtained from the surroundings and where inconspicuousness is almost unattainable. These targets are, however, capable of rapid movement, and protect themselves by this movement and by the use of armour. Naturally, then, their artillery consists wholly of direct-firing guns with high velocities.

It must not be forgotten also that, compared with coast guns,

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ships possess a certain inherent disability for accurate fire in the unsteadiness of the gun platforms, in range-finders inferior to those in use on shore, in difficulty of observation of fire, and in the impossibility of efficiently communicating the ranges to the guns.

About the other form of attack, that by torpedo boats, there is not so much doubt as to the method. Here it is fairly certain that the boats will run in without firing, trusting for safety to a surprise attack, their small size and rapid movement.

Design of Batteries for Use against Ships.

From the above it is evident that two classes of batteries are required, one to take part in the contest with the ships, and the other to stop the torpedo boats. For the first heavy guns are required, which must be long-ranging in order to engage those of the ships when the latter are *trying to come in to close quarters* and least able to reply effectively; they must also possess good penetrative and shell power, and naturally have as rapid a rate of fire as can be obtained. For the other class the gun required is a much lighter one, with a very rapid rate of fire and a size of shell suited to its particular target.

The strategy of the subject and the scale of the defences are questions too large to be touched on here; so we may at once pass to the siting and design of the batteries, the heavy batteries being considered first.

Like most works of fortification, a coast battery must be viewed in two aspects, the offensive (or active) and the defensive (or passive). These are very much intermingled, so the design of a battery is a compromise, which is obtained by first fulfilling the conditions necessary to obtain the maximum of offensive power and then laying down what is really required from a defensive point of view, and, where the two clash, sacrificing only just as much of the offensive as is essential to the efficient working of the battery. However, for the sake of clearness, the two aspects will be dealt with separately; and the offensive, being the most important, will be taken first.

Requirements in Offence.

Viewed in the light of the offensive a battery consists merely of the guns and the means of firing them; and, to obtain their full effect, *nothing should interfere with the arrangements for securing the most accurate and the quickest rate of fire*, qualified, of course, by the reservation in the last paragraph.

It may be as well to see what is implied by the words italicized.

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The gun must be mounted so that it can be loaded rapidly and also traversed easily and quickly in order to pick up a target at once and follow it up; each gun must have a fairly wide arc, so that the greatest possible volume of fire from the whole fortress may be obtained and the full value got out of each gun; this last involves placing the guns some distance apart,* yet the ammunition must be supplied to each gun at least as quickly as it is used up. The battery must therefore be designed to fulfil these objects as much as possible.

As in field fortification before designing a trench it is necessary to choose its position, so with a coast battery before proceeding to its details it is necessary to select its site. Every battery will have to cover with its fire a certain area of water, and this may often be effected from many positions; but in choosing the right one the most important point to be decided is, at what level should the battery be placed in order to obtain the best fire effect? The answer to this will be seen to apply to every battery, irrespective of its particular duties, and is best given by enumerating the advantages and disadvantages of high sites, with regard to fire effect.

High *v.* Low Sites.

Advantages of high sites:—

(*a*). A high site gives greater accuracy in range-finding with most instruments. Two of the methods used in our service for range-finding, namely the depression range-finder (which must be near the gun) and the automatic sight, depend upon a vertical base, and the longer this is the more accurate they are; and for long ranges height is essential.

(*b*). A high site increases the size of the target for the gun, as it brings the deck of the ship into view. From high batteries at short ranges deck attack would be very telling in its effect.

Disadvantages of high sites:—

(*a*). A high site involves a certain amount of unseen or "dead" water. This is owing to the fact that the amount of depression which can be given to a gun is limited, and at a height of say 400 feet this zone of unswept water will be of considerable extent. When the water is shallow this will not matter, but should the water be deep it will be necessary to sweep the dead space in front by fire from another battery.

(*b*). In some cases a high site involves a loss of range and, in

* But this separation of guns must be limited, because, beyond a certain distance, it does not increase the arc of fire, since premature bursts make it dangerous for one gun to fire too close to another.

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consequence, of penetrative power. This must be accepted, in consideration of the preponderating advantages.

Before the decision as to the best level can be arrived at, it must be remembered that the target of a shore gun is not a mere point but possesses considerable dimensions; so that, within certain limits of range, a gun firing with a constant elevation will be sure to make a hit on a ship somewhere, and at long ranges a hit somewhere is all that can be expected. The space between these limits of range is known as the "dangerous space."

Firing at short ranges the flat trajectories of modern guns produce longer "dangerous spaces" from low sites than from high. (At long ranges the difference is slight). But this is not of much consequence with these heavy gun batteries, because it may be assumed that the ranges of their targets will be known with fair accuracy.

Thus, weighing the *pros* and the *cons*, it is evident that, so far as the offensive side of the battery is concerned, *i.e.*, the guns, a high site is the best position.

Requirements in Defence.

So far only the offensive side of the battery has been dealt with; but the defensive must also be taken into account, and this depends on the guns of the ships. What we require to know is, *the kind of damage* which the ships *can* effect, *how much* of it they may be expected to do, and how this may be guarded against?

The projectiles which an enemy might use are various. Shrapnel is little to be feared, since the task of bursting a time shell in the right place to search an emplacement is too hard from a long range, while from a short one the bullets would have very little drop, and in any case it is easy to provide cover against them by shields. Percussion shrapnel would not be so effective as common shell. In a direct hit on gun or mounting the effect of solid shot or common shell would be about equal, and the odds are that disablement to the piece would ensue, unless the hit was a very glancing one. It would not matter very much what gun the projectile was fired from, counting from such a piece as the 4·7-inch or, at all events, the 6-inch upwards; the heavier guns would not do very much more damage than the lighter ones. A hit of this nature is the one most to be feared, but experience has shown that it is not very probable.

In the case of common shell bursting in or near the emplacement, say on the parapet in front of the gun, the gun itself would probably not suffer unless the burst were close to it, while the detachment would be fairly safe behind a shield, and in some cases the mounting itself would form an effective traverse. The rear of the gun must

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not be forgotten; and, by giving nothing for a shell to "bite" on behind the battery, any danger from "back-burst" is almost entirely prevented.

The lighter guns of the ships, from which the most accurate fire of their whole armament may be expected,* may be counteracted by the use of the shield referred to above, except in the case of a direct hit on the gun, and then in about nineteen cases out of twenty the projectile would glance; indeed, it is not certain if a direct hit from these guns would be disabling.

The claim is sometimes made that the ships' fire will be of such a volume as to "smother" the batteries; and, if the ships can get to close quarters, say about 1,200 yards, the claim seems well founded; so every effort must be put forward to prevent this close approach. The effect of an accurate fire from a battery against a ship must be a very telling one in the way of preventing an accurate return, especially if the battery can get in its fire before the ship reaches its most effective ranges. It was while approaching to take up a position at Sebastopol that *The Queen* was so damaged by the cliff batteries that it had to draw without effecting anything. As in all truly conceived fortifications, the real defence lies in the offensive action.

Should the ship be able to come in close without being disabled, it is far more likely that a battery would be silenced if it were on a low site than if it were on a high one. For this reason, if the only available sites were low and there were deep water close to the shore, it would be advisable to withdraw the battery from the water and so deny the ship the possibility of "closing it."†

In effect, apart from the smothering fire at close quarters, which must be met by a vigorous offensive early in the action and by good siting, the maximum damage that a ship can do is to get direct hits on the battery gun. In these remarks on the effects of ships' projectiles only the gun and emplacement have been mentioned; a hit on any other portion of the battery may be

* Instance the American fleet at the actions of Santiago and Manila.

† An early example of this smothering fire is given by the daring attack on San Juan, in Porto Rico, by the Earl of Cumberland. In 1595 Drake's fleet attacked the place and was repulsed after several attempts, the ships suffering severely from the fire of the batteries, amongst which was Fort Bocqueron. This fort, in addition to bearing on the sea, commanded the land approach to the town, which lay along a narrow isthmus. In 1598 another attack was made by the Earl of Cumberland, who, in order to take the town by a land attack, *ran one of his ships on the shore in front of Fort Bocqueron*, by its fire destroyed the fort, and so opened the way to the town.

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practically neglected, as it is comparatively easy to render the whole of the remainder quite safe.

Such being the nature of the damage *possible* from ships' fire, it remains to consider the *probability* of its being effected. Here we can only go to actual instances to see what naval artillery has done, and make deductions from those and from peace experiments.

One of the most instructive instances in the past was the naval attack on Sebastopol (*Plates* I. and II.). There the English in-shore squadron engaged three works—Fort Constantine, a large masonry casemated fort with barbette guns upon the top, which rose from the sea at the mouth of the harbour; a small brick fort called the Wasp Battery, on a cliff 110 feet high; and the Telegraph Battery, an earthern one on the same cliff; the two batteries had each five guns on the sea fronts.

From a range of 800 yards 22 out of the 27 barbette guns of Fort Constantine were silenced in a very short time by the fire of three ships, the splinters from the stone walls causing a great deal of damage. But the other two batteries caused the retirement of the whole squadron with considerable loss, while they themselves suffered very little, the Wasp Battery having one gun-carriage upset and 22 men wounded while the Telegraph sustained no loss at all.

The immunity from damage of these small works, compared with the severe loss in the much larger one, may be traced to several causes. Their superior height deprived the ships' fire of any searching effect, while their own fire, which was necessarily more accurate than that of the lower fort, must have had a great effect on the naval shooting. Another cause was undoubtedly the difference of the targets. In the case of Fort Constantine there was a clear cut outline of a stone wall, giving an excellent mark to aim at, while the range could be readily obtained since the base of the fort was washed by the sea. In the case of the Telegraph Battery all that the ships could see was a low earthwork, and from the decks we are told it was impossible to ascertain the effect of the ships' fire, showing what an inconspicuous target the battery must have presented. The Wasp Tower was so concealed by its glacis that the Allies hardly knew what its form was. Moreover the batteries were withdrawn from the water line by the slope of the cliff, rendering it impossible to find the range by using the ordinary range-finder which was available against Fort Constantine; and, finally, the observation of fire must have been very difficult owing

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to the dip in the ground behind the works, which prevented the naval gunners from seeing where shots going over were striking.

Too much must not be argued from a single case, but there are other examples which confirm the lessons of the naval attack on Sebastopol. At Alexandria the conditions were almost wholly in favour of the ships, namely, smooth water, works not only on very low sites close to the water but badly designed (some being unfinished), a poor armament and inexpert gunners; yet the shooting of the ships had very little real effect, and against better troops the fleet would hardly have gained its object. This was, no doubt, principally due to the nature of the naval armament, which consisted to a very large extent of slow-shooting heavy guns, few in number; so that the number of effective projectiles was small. For the purposes of an engagement against batteries the fleet at Alexandria was at its worst period as regards guns, as it lacked numbers or, what would have come to the same thing, a rapid rate of fire.

In the Spanish-American War the ranges at which the ships fired were far too long to be effective against the batteries, and as a consequence the fire did little damage.

In addition to these instances from actual warfare, we have the experience of peace experiments, such as those at Inchkeith and the Severn, etc. Under this category may be mentioned an incident which occurred in the Franco-Chinese War, showing that high-sited guns, even when on the sky-line, are not an easy mark under any conditions. Admiral Courbet wished to destroy an unoccupied Chinese barbette battery of four guns on a shoulder of a hill about 100 feet above the water, and, apparently for the sake of practice, ordered it to be carried out by fire from the ships. After 40 rounds from the 5½-inch guns the firing was stopped because none of the guns had been hit.

From the consideration of all these cases it can be safely asserted that under no conditions is it an easy thing for naval gunners to hit a barbette gun, and that it will be especially difficult when the battery is high up or situated that the ship cannot come in close. (The corollary of this is that under these circumstances the battery should have sufficient time to disable the ship).

We are now in a position to see what a battery really needs to protect it from ships' fire. There are three parts of it which require protection—the guns, the ammunition and the men.

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To take the men first. Those serving the guns are naturally the most exposed, and have to be protected by the shield already mentioned; the remainder of those above ground will be sheltered by the parapet, which will have to be continuous in order to afford free and secure communication along the whole battery. (As will be seen, the shelter afforded by the parapet increases with the height of the battery above the water). Protection of Men.

The ammunition may easily be protected by being kept in sunk magazines, so that it will be practically an impossibility for an enemy's projectiles to reach it; while the means of conveying it up to the guns must also be under cover. Protection of Ammunition.

Lastly, there is the gun and its mounting, which is the real vulnerable portion of the battery, and practically the only one. Here is where the battery is at such an immense advantage as compared to the ship.

A hit on a ship is a different matter to a hit on a battery. The latter can be so constructed that a hit, unless on or near the gun, will be practically thrown away; while a hit on the ship, even if it does not penetrate the armour, may reach an unarmoured portion and do damage; and even a hit on the armour, which does not penetrate, will have a certain moral effect, or it may jar and damage some part in the interior, or place *hors de combat* some of the crew by mere concussion (as occurred in the fight between the *Merrimac* and the *Monitor* and at the Battle of the Yalu).

It is a question whether the gun itself should be protected by armour, as is often the case on the Continent. Of course this does afford good protection, in fact the best that can be given, since only shot which hit the chase of the gun or penetrate the armour would be effective. But it is not really necessary, because the extra advantages it confers are more than counter-balanced by its disadvantages; and it cannot be said that ships' fire is so accurate that no other form of mounting can possibly be worked under fire. The disadvantages of armour protection are:—Firstly, it is very expensive, and the money expended on it would be far better employed in providing more guns; secondly, practice from guns in cupolas or turrets will never be so easy or so rapid as from guns in the open; thirdly, such forms of protection will intercept some projectiles which would otherwise pass over and do no harm, and hits on the armour cannot but have a prejudicial effect upon the steadiness of the mounting; finally, such forms of protection afford very good targets to the ships. Protection of Guns.

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Another method of protecting the gun is to mount it on a disappearing carriage; and this has often been employed. In a barbette mounting the gun is always exposed, while in a disappearing one the exposure is only for a short time. Therefore, from the defensive point of view, the latter would undoubtedly be superior; but from the offensive, which is the most important, the barbette mounting is better. It is simpler and very much less liable to get out of order; it allows a quicker rate of fire; it admits the use of auto-sights, which would hardly be possible on a disappearing carriage; and, finally, it is cheaper. It has been seen that it is by no means an easy thing to hit a gun; so that from the defensive side it is not necessary to go in for a disappearing gun, and the almost universal practice will be to place coast defence guns on barbette mountings.

In place of protecting the gun by such methods as the above the necessary security is sought for in the following directions:—

(1). The position of the battery with reference to the water line.

(2). The form of the battery.

(3). The inconspicuousness of the battery.

(1). The position of the battery with reference to the water line. Looked at from the defensive point of view, the battery should be withdrawn from the deep water and should also be placed high up, and this last for two reasons. The higher the battery is the less will be the slope of descent of the enemy's projectiles, and the greater the protection afforded by a parapet; this will be especially the case at short ranges. For instance, a projectile from the French 27-c.m. gun will have a slope of descent of only 8 degrees when it reaches a battery 400 feet high from a range of 4,900 yards; while from 1,000 yards the trajectory will be an *ascending* one of 6 degrees (Clarke's *Fortification*). Secondly, the reduction of the slope of descent, due to the height of the battery, will help greatly in causing the projectiles to ricochet; this may be taken advantage of also in the form of the battery.

(2). The form of the battery. Both the plan and the section of the battery will be designed to assist in giving protection.

So far as the plan is concerned, the guns will be separated to such an extent that it will be necessary for the enemy to direct his fire on a particular gun and not on the battery as a whole. (This separation of the guns is also advantageous from the offensive side in that, within limits, a large arc of fire is given to them). To guard against enfilade fire, and to localize damage from bursting shell, there

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should be traverses between the guns or, what is the same thing, each gun emplacement should be a recess in the parapet.

As to the section of the battery, every advantage must be taken of the tendency of projectiles to ricochet. The superior slope of the parapet should be as gentle as possible, having due regard to the fact that it must be steep enough to allow the gun its maximum depression or, at all events, as much as is required by the site; and its upper portion should be formed of sand, which experience has shown to be excellent for the purpose. Furthermore, for a considerable distance behind the parapet, there must be nothing in the nature of a vertical surface which might cause a shell to burst.

It is usual to give a considerable thickness of concrete in front of the guns, to prevent damage by blast; it requires to be considerable in area also on account of the length of modern guns.

Many experiments have been carried out to determine the penetration of projectiles into earth and concrete; but this does not now really affect the question of protection very much, since the idea is to prevent the shell entering at all rather than merely to stop it when it does; and it must be remembered that in these experiments the projectiles were in most cases given practically vertical faces to act against, which would very rarely be the case in reality. At short ranges almost every shell would ricochet, even from low-sited batteries; while at long ranges, with the corresponding steeper slopes of descent, the difficulty of hitting at all would be largely increased, and even here ricochets might reasonably be expected. However there is one case in which the penetration should be taken into account, namely, when it is necessary to have the parapet well above the natural surface of the ground with a fairly steep exterior slope; then the length of the superior slope or, in other words, the thickness of the parapet, should be sufficient to stop the projectile before it can reach anything vulnerable; in most cases 40 or 50 feet of sand and earth would be enough, or concrete may be used as well.

(3). The inconspicuousness of the battery. Thirdly, there is the inconspicuousness or, as it is generally called, the "invisibility" of the battery; and this can be of very great assistance in its defence. It includes all means of rendering the battery difficult to range on, and of making it a bad target to lay on when the range is found; its invisibility is effected by the form and by the site of the battery.

As regards the form, the battery, as viewed from the sea, will be made to harmonize as much as possible with its surroundings

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and background, the surface of the ground being altered only when unavoidable. Sharp changes of slope will be avoided, painting may be resorted to, and the aid of planting called in should the surroundings be of a wooded nature. That these things are necessary goes without saying, although no strict rules can be laid down, every case having to be considered separately.

A great deal can be done by judicious siting; and, since the guns of a battery will always be visible and will appear unnatural objects, an endeavour must be made to choose a site where they will be as little prominent as possible. This will be secured by having a background of the same appearance as the slopes of the battery, which will usually be grass.

These requirements, so far as site is concerned, will often be difficult to reconcile; so that a compromise may, and generally will, be necessary. Recapitulating the conditions which are most often the conflicting ones, they are :—

(*a*). The necessity of a large arc of fire, which often involves allowing the gun to fire down to its extreme angle of depression, at all events for the central portion of its arc (this can hardly ever be obtained for the whole of it).

(*b*). The desirability of a background to the battery, and, we may add, of

(*c*). a dip in the ground behind the battery, not only to avoid catching shell, but also to prevent the enemy seeing how far any projectiles go over.

Often one has to decide between placing a battery on the top of a slope on the sky-line (as at A in *Plate* III.) or somewhere on the forward slope of the hill (as at B on the same figure). In the first case the condition (*c*) is fulfilled but not condition (*b*), and in the second case it is the other way round; it is assumed that condition (*a*) is fulfilled in both. This first condition (*a*) is paramount; but can be effected sometimes by cutting away to a certain extent any rise in the ground in front of the guns which interferes with the fire, or by giving a certain command to the battery, raising it above the natural surface of the ground. It is, of course, advantageous to keep this command low, both for the sake of invisibility and for the probable economy in getting proper foundations. This question of economy will always have to be taken into account and really forms a fourth condition; for instance, A would in most cases prove a cheaper site than B owing to the smaller amount of excavation requisite. In some cases A may necessarily have to be adopted on

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account of the narrowness of the ridge or the steepness of the front slope. Position C (*Plate* III.) on the edge of a cliff will be a distinctly bad one, since it will be considerably more conspicuous than either of the others, it will be close to the defined edge of the cliff and, if the cliff is at all vertical, the range can be more readily obtained by making preliminary use of the water line for the purpose of observing the fall of the shots. Withdrawal from the line of the water should always be done not only in high sites but also in low sites, even in those which are only a few feet above the level of the sea, unless the water in front is very shallow.

When conditions (*b*) and (*c*) come into conflict as in the section of ground shown in *Plate* III., no actual rule can be given as to which is to give way, and local circumstances must decide. But probably in the majority of cases, provided the slope is not steep, position B would be adopted.

Both aspects of a battery have now been considered, and the results arrived at may be summed up:—

The guns must be given fairly wide arcs of fire, but care must be taken that these do not involve exposed emplacements. Guns with shields would be very vulnerable to reverse fire.

A high site should be selected for all batteries whenever the ground permits, even at a loss of range.

For purposes of invisibility, and for preventing ships getting too close, batteries should be withdrawn from the navigable water.

A good background is desirable, and also a dip in the ground behind the battery.

Barbette guns with shields will almost invariably be employed, with wide intervals between them.

A high site is also favourable to security from attack by landing parties, and as a rule it presents fewer difficulties as to foundations than a low site. In tropical countries it will also be probably more healthy, an important matter since the gun detachments should live near their batteries.

There is, however, a point which requires consideration when choosing sites for batteries in certain places, and that is the prevalence or otherwise of fogs or mists. In some places these are frequent and generally the fog line is fairly constant in its level. According as the fog or mist is a low-lying one or one which envelops the tops of hills, so the level of the batteries must be made to suit.

Looking to history, there is hardly a case in which high-sited batteries have not proved their superiority over ships. Besides the

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cliff batteries at Sebastopol, the actions may be mentioned of Algiers and Lissa, while the examples of the American Civil War deserve special attention. In this struggle there were many contests between the Federal ships and the Confederate batteries, both on the Atlantic coast and on the Mississippi; in many of the fortifications there were, unfortunately for the Southerners, what were termed "Water Batteries," for the special purpose of engaging ships; these were close to the water level, and in every case where they were attacked they suffered severely, while the higher batteries came off much better.

At Grand Gulf, on the Mississippi, there were two batteries, each of four guns, one 75 feet above the river and slightly retired, the other low down and close to the water; these works were engaged by seven gunboats for 4½ hours; the lower battery was silenced, while the upper one handled the gunboats so severely that they were forced to retire with heavy loss.

At Vicksburg four gunboats fought the low water batteries for two hours at 450 yards without suffering material damage.

On the Tennessee River, Fort Henry, another water battery, had to surrender after a two hours' fight with several gunboats, having seven guns silenced out of eleven in action. The same fleet engaged a work of about the same number of guns a few days later, Fort Donelson on the Cumberland River, and was repulsed with great loss; in this second case the guns were divided into three batteries, situated respectively 20, 50 and 120 feet above the level of the water; even the lower batteries suffered very little, due probably to their superior height compared with Fort Henry, while from views of the two works the latter was undoubtedly the more conspicuous and blended less well with its background.

At Kiel, in 1870, the height of the batteries was given by the French Council of War as one reason why they should not attack the place.

This completes the general remarks as to heavy gun batteries, so far as these are common to all batteries, irrespective of their particular duties in the scheme of defence of any fortress.

Design of Batteries for Use against Torpedo Boats.

The other distinctly different form of attack is that by torpedo boats. The batteries necessary for this purpose will be armed with light guns.

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The data of the question and the deductions from them may be stated very briefly :—

The attack will probably be by night or in foggy weather; at all events, this is the time when there is most to be feared from an attack. It is then essential that the area of water over which the guns are to fire should be lit up. This is an expensive matter in money, men and material, so the area to be illuminated must perforce be limited; this means that the guns must be at the narrowest part of the approach channel, since the whole breadth of the channel must be illuminated.

The boats will not waste much time in firing, but will trust for safety, in case of being discovered, to their rapid movement and their small size; therefore the question of *defence for the battery* becomes a secondary matter, the main idea being to get in as many hits as possible. The ranges will probably be short and difficult to determine; so it will be of great importance to have guns so placed that they have a large "dangerous space," making use of their flat trajectory; this involves low sites for the batteries. Experience has shown, however, that Q.F. guns, if they are placed too low, cannot see boats in electric-light beams, the sources of which must be on low sites. For this reason (and also as a rule on account of range-finders) these batteries are, if possible, somewhat raised above the water.

Considering the two aspects of these batteries in the same way as before, the offensive side is all-important. The best level for the guns has already been arrived at. A good field of fire is the first requisite, and the guns, being so much smaller than those for fighting the ships, may be placed nearer together without interfering with each other's fire.

The dead water from such low sites will be small, and the mounting usually allows a considerable angle of depression; but it must be remembered that the limit of navigable water for torpedo boats is much nearer the shore than for larger vessels.

Similar arrangements for the storage and supply of ammunition are required as in the other batteries.

The defensive side of these batteries is of less importance than in the case of the heavy ones. In fact, where they are removed by distance from any chance of being hit by ships' fire (except, of course, in the improbable case of the ships themselves trying to come into the harbour), the site may be chosen solely with reference to the offensive requirements, *i.e.*, the gun.

As a rule it will be sufficient to guard against rifle fire and very

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light shells; and the defensive requirements will be fulfilled by giving shields to the gun, protection to the ammunition, covered communication throughout the battery and no steep face behind the guns for shell to burst upon.

Application of Batteries to Different Sites and Duties.

Having now gone through the points which are common to all batteries, it remains to consider the application of batteries to different coast lines and the varying duties which they may be intended to perform. These may be divided generally into two classes :—

(1). Defence of a harbour.

(2). Defence of a landing place.

Another rare class might be the defence of a channel leading to open water, but this practically comes under the head of one of the cases of defence of a harbour.

Defence of a Harbour.

(1). This is the general case of coast defence; but, as the variations in the shape of and in the approaches to harbours are innumerable, some classification is desirable. There are two general types which can be considered, namely, the case of a harbour having an approach channel either long or short and broad or narrow, and the case where the coast line is to all intents a straight line, the harbour possibly being formed by breakwaters; the latter is the one most unfavourable to the defence.

The distribution of the batteries will vary with the size and scale of defences for the place. If both these are small the defences will probably be congregated about one spot; if they are large there may be several lines of defence supporting each other.

In speaking of "siting" batteries in the various cases following it must be understood that they should *always*, if the ground be suitable, be placed *high up* and *retired from the navigable water*; but, as many sites will fulfil both these conditions, we are concerned here with selecting the best of them.

When batteries are intended for the protection of a harbour (or the defence of a channel) they should be sited in accordance with two leading principles, which follow the one from the other, namely, that they should be dispersed and that they should be able to concentrate their fire; and this applies to all cases. To effect this properly, their distance apart should not be too great, and in many cases the water in front of one high battery has to be defended by

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the fire from another. The batteries at the seaward end of a line will naturally come under fire before the rest, but this fire will be a distant one from which they will suffer very little; but when the ships close to the decisive ranges, these outer batteries should not be so far to the front that they will be unsupported by a cross fire from their neighbours.

An instance of the violation of this principle was given at Cartagena in 1741. Two small batteries were placed in front of the main line of defences, and were so situated that ships attacking them at close quarters were out of the arc of fire of any other guns; in these circumstances they were easily silenced by three ships of Admiral Vernon's squadron.

When there is a straight coast line the enemy will be equidistant from the batteries and from what they are defending; thus the guns must be able by their fire to so engage the attention of the ships that they must either retire or, at all events, confine their efforts to attempting to reply to the batteries. All that can be said about these is that they will be placed according to the leading principles for siting, and as a rule would be on both sides of the harbour. The actual entrance of the harbour will generally be small, and can easily be defended by the fire of light guns and the employment of submarine mines, while to assist in keeping out torpedo boats a boom might be used.

The straight coast line is, however, the exception; it is more usual to find a fortified port in an indentation of the coast, providing a channel of approach which may be broad or narrow and long or short. In deciding upon the general position of the defences, the chart must be studied as well as the map, as advantage will naturally be taken of any difficulty presented to the navigation by rocks, shoals, winding passages, etc., and a strong fire will be brought to bear upon such spots.

If the channel is a very broad one, say 3 or 4 miles, the fire from batteries on the shore will be very weak, and those on either side will not be able to give efficient mutual support. As instances of this, there are the cases of Mobile Bay and the Port Royal Expedition in the American Civil War.

In such a case it may be necessary to construct forts in the sea, which will often be of a very different type to the batteries hitherto described, inasmuch as they may have to depend for their protection on the thickness of the material employed, unless the artificial formation of islands be possible, as at Spithead, Cronstadt, and the

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forts at the entrance of Tokio Bay in Japan, where the batteries are earthworks on artificial islands.

But as these cases are exceptional and require special treatment, they need not be enlarged on here. The ordinary case of a harbour resolves itself into a channel narrow enough to admit of being swept effectively by batteries from the shore.

If the channel be a long one this case practically merges into that of stopping ships running through a channel. Here the fundamental principle is that, if there be clear water beyond the batteries, gun fire alone is not sufficient to stop ships. There must be some kind of obstacle to keep them under fire, and this may be of a passive nature (*e.g.*, sunken ships), or it itself may be active (*e.g.*, submarine mines), the latter being the more usual.

The necessity of an obstacle has been proved in many instances in the past (*e.g.*, in the Paraguayan War), but perhaps most conclusively at Vicksburg, in the American Civil War, where the circumstances were all against the ships and yet they several times went past with very little loss. The ships were slow, the navigation was difficult, the current of the river was strong, while on the shore was a line of batteries, well placed high up and commanding at short range a turn that had to be made by the fleet; but the error was that there were no obstacles in the way of the ships' progress (*Plate* IV.).

On the other hand, in the same war, some of the Union fleet proceeded up the James River, successfully passing and silencing the Confederate batteries, until they came to Fort Darling at Drewry's Bluff. This battery was placed about 200 feet above the river, and in front of it were a few sunken steamers in the stream under the fire of its guns; under these circumstances the battery was completely successful.

In this, then, the most general case of coast defence, a harbour with an approach channel, the following points will determine where the batteries should be placed :—

(*a*). They should be placed so that they will keep the enemy at a safe distance from the objective of the defence, *i.e.*, beyond effective range.

(*b*). They will naturally command the narrowest portion of the channel, or any part of it which may be difficult to navigate.

(*c*). Each battery should have a wide arc of fire, for which reason spurs and projecting features of the ground will often be chosen for the sites. This wideness of arc must, however, be kept within limits, as for one thing it should not be possible for the ships to

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enfilade a battery, and for another it is desirable to keep down the arc of fire of individual guns in most cases to somewhat below 180 degrees in order to allow of the space behind the gun being kept clear; the limitation follows as a necessity when there are several guns, as they would otherwise interfere with each other's fire.

(*d*). In the zone of water defended by the batteries there should be no "dead water" where ships could manœuvre; at least one battery should be able to cover every part of the navigable area. This was clearly seen in the case of the *Agamemnon* at Sebastopol, in the attack upon Fort Constantine, after the barbette guns in the fort had been silenced; the ship would have been safe from the enemy's fire if the cliff batteries had not been able to command the water where she was, as it was beyond the arc of fire of the casemate guns at the fort. Also in the Port Royal Expedition (South Carolina), in the American Civil War, Fort Walker was especially harassed by the fire of two or three vessels which passed in beyond it and took up a position whence they could enfilade the fort, which had no guns bearing on this spot, Fort Beauregard, on the other side of the channel, being too far away to bring an effective fire to bear (*Plate* V.).

(*e*). The most powerful guns will be placed on the outer flanks of a line of batteries; or, in the case of a single battery with two natures of guns, on its outer flank.

(*f*). In the line of defence there must be something to delay the ships; this, with us, is usually a submarine minefield, which may be termed an active obstruction. This must be under fire to prevent its removal, and this fire may be furnished by the main batteries or by others specially intended for the purpose.

(*g*). As well as the obstruction mentioned in (*f*) there would be, in the most important places, in addition to the light batteries already described, a boom at the actual entrance of the harbour, if sufficiently narrow, for protection against torpedo-boat attack.

Defence of a Landing Place.

(2). The second object for which coast batteries may be required is the protection of a landing place. Two cases arise here. Firstly, the shape of the coast line may be curved and the available space for landing small, so that from the extremities of the bay guns can cover the whole of the water across which the boats containing the landing parties must come. It will usually be possible to site the guns behind natural or artificial cover, so that they cannot be put out of action by the fire of the ships. Light guns are all that are required for the purpose. Secondly, the coast line may not lend

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itself to this arrangement, either being too straight or the length to be defended being too long to be covered from the extremities. It will then be hardly possible to conceal the guns from the view of the ships in the deep water, and batteries must be provided to engage the ships themselves as well as deal with the boats containing the landing parties.

Defence of Batteries against Attacks by Land.

This completes the remarks to be made about coast batteries as such; but there is a point which is of extreme importance, and which must not be forgotten in connection with them, namely, that they are purely gun positions for firing at ships and cannot defend themselves against land attacks. In the past many coast batteries have fallen from such attacks, which must always be reckoned with.

These attacks by land may be of two kinds, either a deliberate attack on the land side of the fortress, in which case the coast batteries stand or fall with the fortress, or a hasty raid on the batteries themselves by parties landed for that purpose.

There are two classes of coast fortresses with which we as British engineers have to deal. One consists of those in the United Kingdom and India, and Malta and Gibraltar may be included, where there will be a large field force available for defence, in addition to the garrisons of the batteries; the other class comprises the coaling stations and the smaller coast fortresses in the Colonies, where the total number of men will always be very limited and the attack possibly sudden.

In the first class the defence of the batteries against a raid by landing parties may be left to the field force, the scheme of defence will include detachments told off for this special purpose, and any fieldworks required will be erected only on the outbreak of war. In other words, the land defence of the batteries will be completely outside of them, although in peace time, as well as for additional protection in time of war, they should always be surrounded by an efficient obstacle; and in the last resort the gun detachments will be available, and in certain cases the guns themselves may be of use. But the land defence ought not to depend upon this, as the parapets are not suited to it; the battery should be considered as a *coast battery* only, and not as a redoubt or a fort as well.

In the second class the number of men will be limited, and in

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certain cases the battery may be outside the line of defence of the place and must be able to defend itself. This should not be really a difficult matter, as in this class of place the probable raid will be by parties from the ships' complements; and the opposing forces should be fairly equal when the advantages of the defence are considered. In addition to the gun detachments, a certain number of infantry will be told off for the defence of such a battery, and suitable intrenchments are needed for them. The parapet is not, as a rule, a good place for them to occupy. They should rather be in one of two places, either in trenches below the level of the battery (if high up) on the sides most liable to attack, the rear of the battery requiring special attention, or in trenches or a small closed work on some spot in the immediate vicinity, whence the whole of the battery and its approaches can be commanded. In either case a good use should be made of obstacles, both round the battery and round the infantry post.

A very instructive example of land attack on batteries, which was a method of attack very often employed in the past, is afforded by the action at Petropolovsk, in Eastern Siberia, during the Crimean War (*Plate* VI.). This action is also fruitful in lessons on other points in connection with coast batteries besides the land attacks, and is worth noticing in a certain amount of detail.

The place was a minor naval station, and was attacked by a small squadron of English and French ships.

The defences were as shown on the plan, in which the number of guns in each battery are shown. The attacking ships numbered 3 frigates, 1 corvette, 1 brig and 1 despatch boat (a steamer), having a total of 210 guns. Two Russian ships were in the harbour (partially dismantled) and a force of Russians in the town, in addition to the garrison of the batteries.

On the 31st August, 1854, the action commenced by two frigates anchoring 1,500 yards off Shakoff Battery and engaging it, while the third frigate opposed the battery by the cemetery. Both works were silenced after some time, the garrison of the former suffering very much from splinters of rock, as it was situated close up in front of a rocky cliff. At the cemetery battery a party of 150 men was landed, who escaladed the cliff on which the battery was built and carried the work and spiked the guns; they then re-embarked, as a Russian force was approaching from the town.

In the afternoon of the same day two frigates engaged the battery D from a position where the Point Shakoff sheltered them from the

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Russian ships in the harbour. After two hours' firing the ships withdrew, the battery having suffered severely. During the day the ships lost 1 killed and 7 wounded ; and they had expended a large amount of ammunition.

On the 4th September two frigates engaged batteries A and B from 800 yards range and silenced them. A landing was then made to the north of A, and the troops hurried up to the top of the ridge overlooking the town. There they met a Russian force which had been despatched to the scene of action and, by having rather easier ground to traverse, had arrived first. The action lasted for some hours ; but, owing to the superior numbers of the Russians, the Allies had to retire with heavy loss, and a few days later the squadron left the place for good.

The points to be noticed in these attacks are several.

(*a*). The fortress was a small and isolated one, and in these circumstances the defences should have been more concentrated. Batteries A and B could receive no support from the remainder, and were too far apart to be of much help to each other. In any case, they were badly sited, as they should have been at the top of the ridge. This position would have involved very little loss of range, and, remembering the success of the Telegraph Battery at Sebastopol at this very time, one can hardly believe they would have been so easily silenced, and until that was done a landing would have been very dangerous. Both these batteries might well have been omitted, as, owing to the geographical conditions, the Russians might safely have reckoned upon having to deal with small landing parties only and have entrusted the safety of these possible points of attack to entrenched bodies of men. As the sequel proved, the infantry force was quite equal to the task of repelling the attack. Had these batteries been omitted there would have been 11 more guns available for the defence of the mouth of the harbour.

The battery at Point Shakoff was in a peculiarly bad site. It was low down, with a rocky cliff just behind it, and, being on the extreme point of the cape, it was exposed to enfilade fire ; while the other batteries were too far off for the guns of the period to give it effectual support. It should have been placed high up, or, if the steepness of the hill rendered that impracticable, it should have been placed further back at the point F, where it could not have been attacked without forcing its assailants to expose themselves to a cross fire from the batteries D and E ; and in this position it could have better supported them.

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(*b*). Another point is the extreme importance of the land defence of batteries *by troops located on the spot* for the very purpose. When battery E had been silenced, evidently by the destruction or demoralization of its garrison (as the guns required spiking, and so must have been uninjured), a landing party had no difficulty in taking it at once, in spite of having to escalade the cliff. The Russian troops, who should have been on the spot, had to come from the town, and so were too late. Much the same was the case with batteries A and B.

(*c*). It is also of use to note the indecision which characterized the attacking force, and the evident lack of definite method on the part of its commanders. Practically all the defence at the mouth of the harbour was broken down, and there were only the two Russian ships left to contest the much superior allied force. Yet four days were allowed to elapse before any further action was taken, and then all the fruits of success in the first encounter were thrown away and an entirely fresh enterprise undertaken, the avowed intention of which was to get some very light guns up to the top of the ridge and from it bombard the town and anchorage. This could have been done from the harbour by the much heavier guns of the fleet, and the two Russian ships would also have been destroyed; and this was really the result most to be desired.

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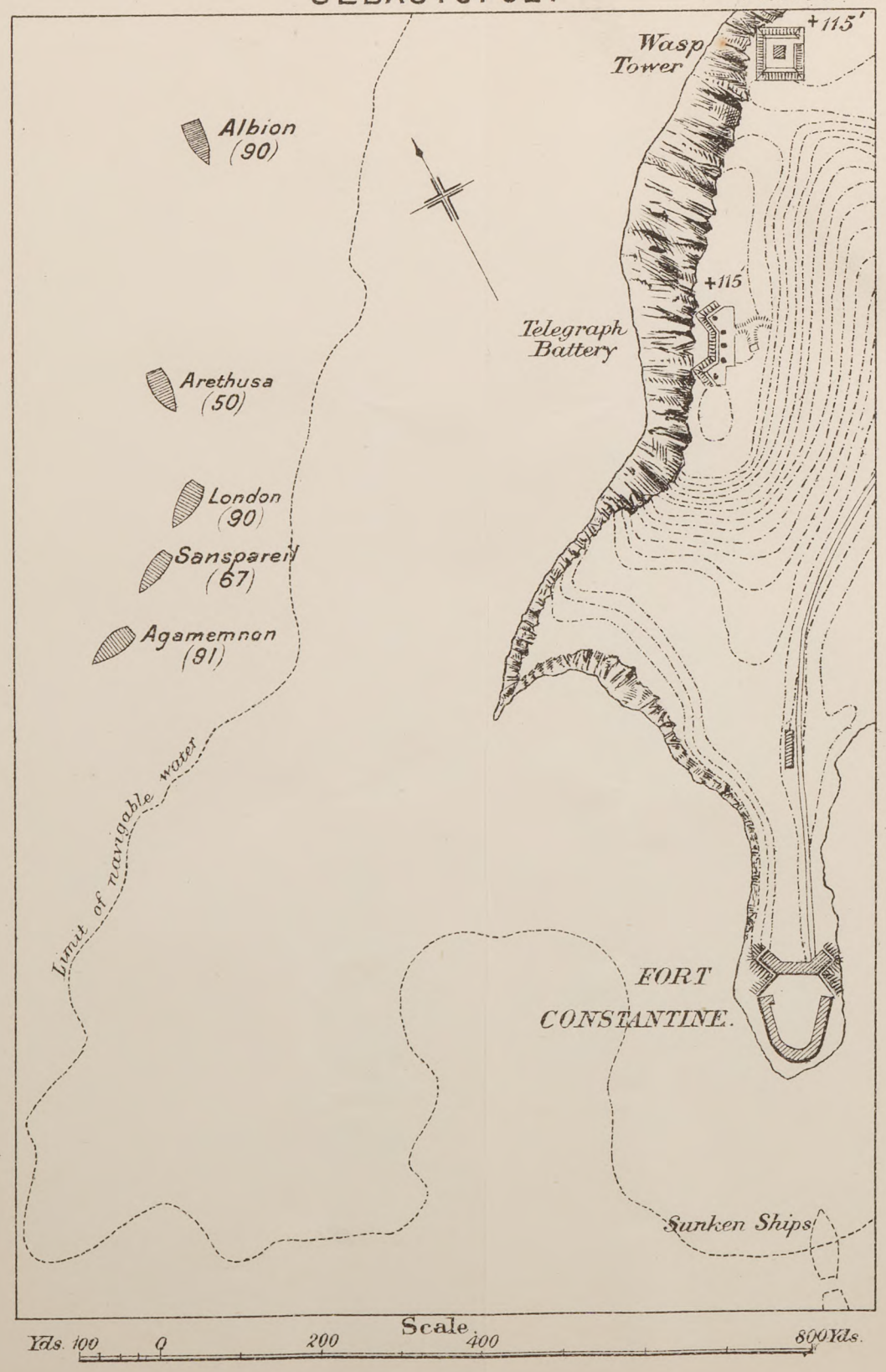
SEBASTOPOL. PLATE I.



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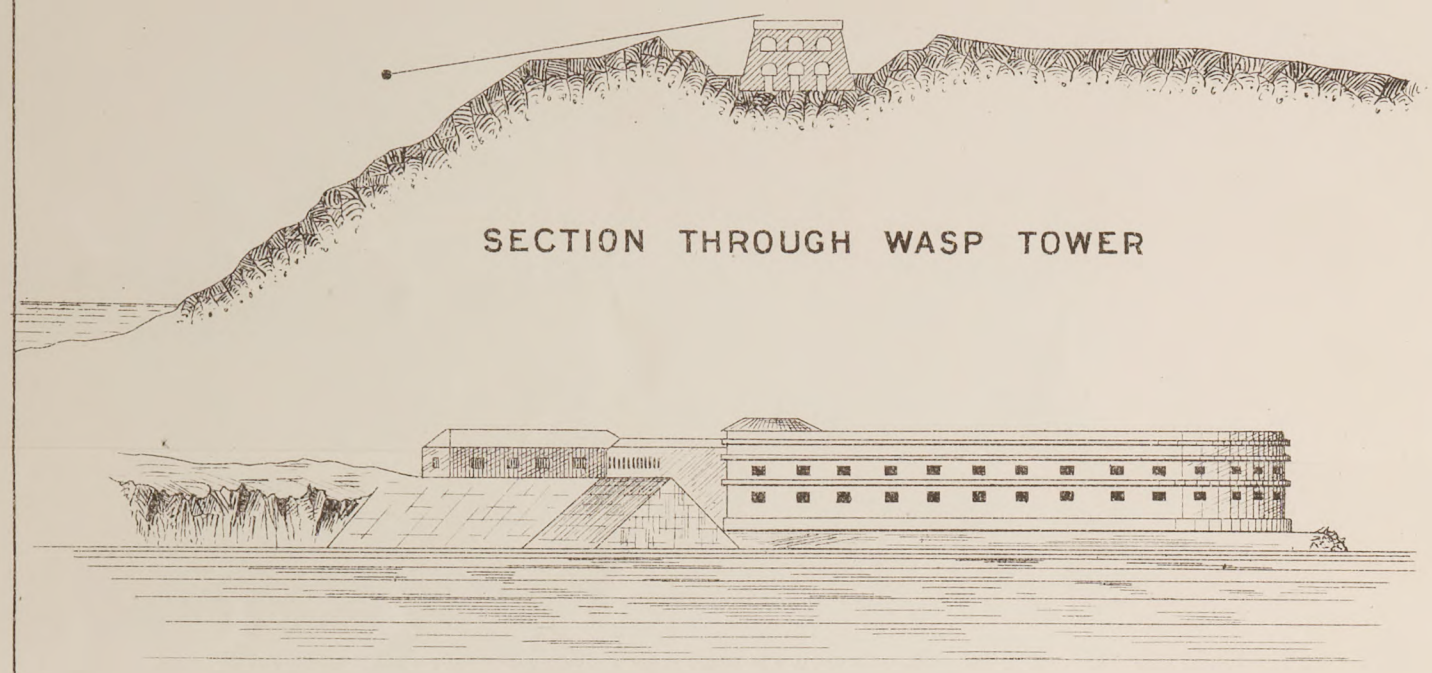
SEBASTOPOL.



SECTION THROUGH WASP TOWER

ELEVATION OF FORT CONSTANTINE FROM WEST

Scale.

Feet 100 50 0 100 200 Feet

PLATE II.

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TYPICAL POSSIBLE SITES FOR BATTERIES.

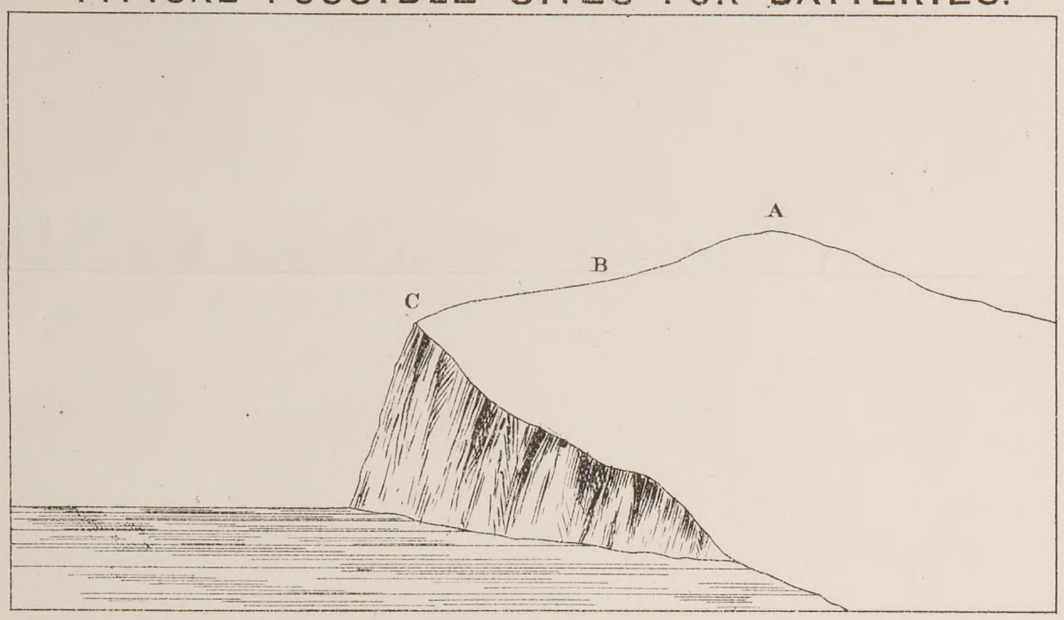

PLATE III.

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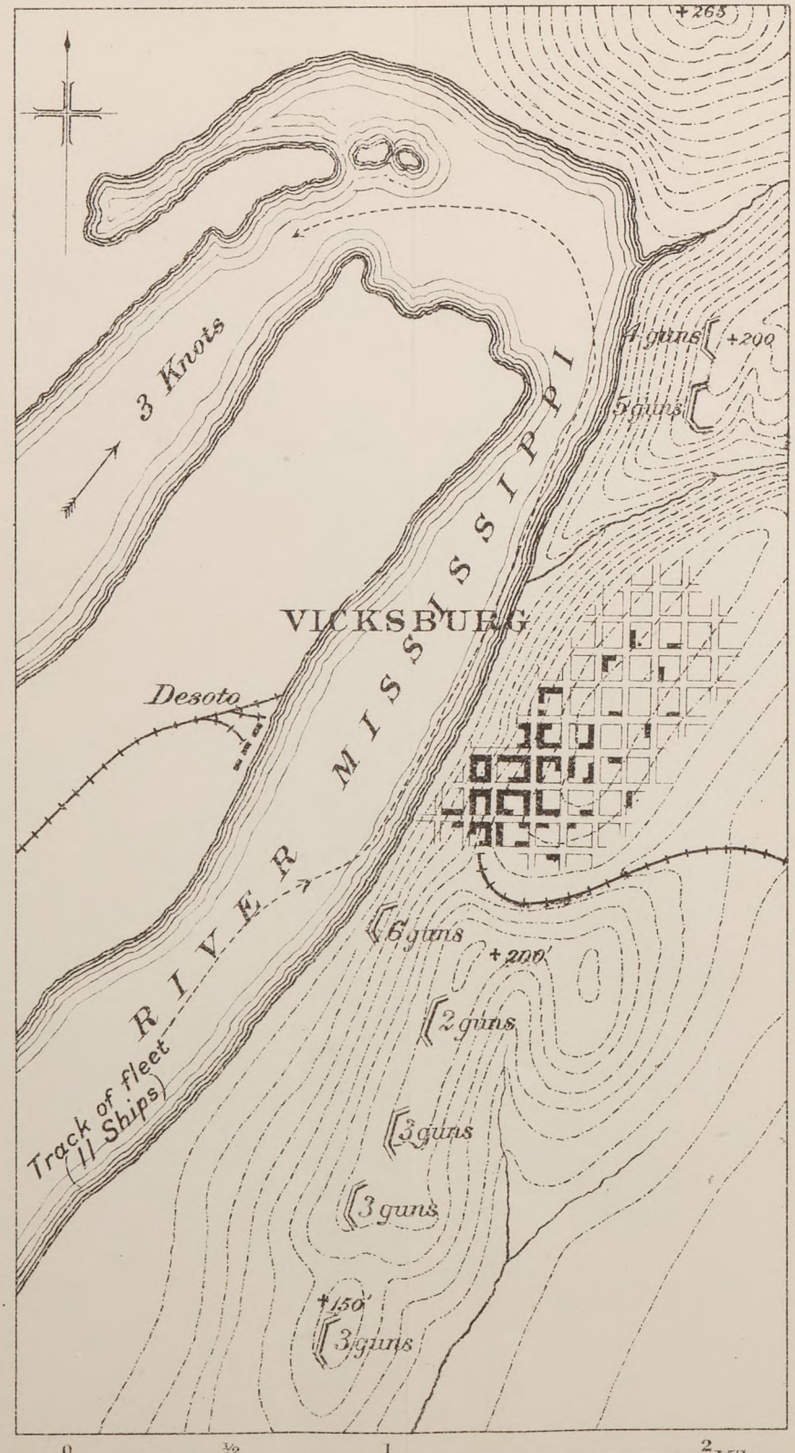
AMERICAN CIVIL WAR 1863. PLATE. IV.



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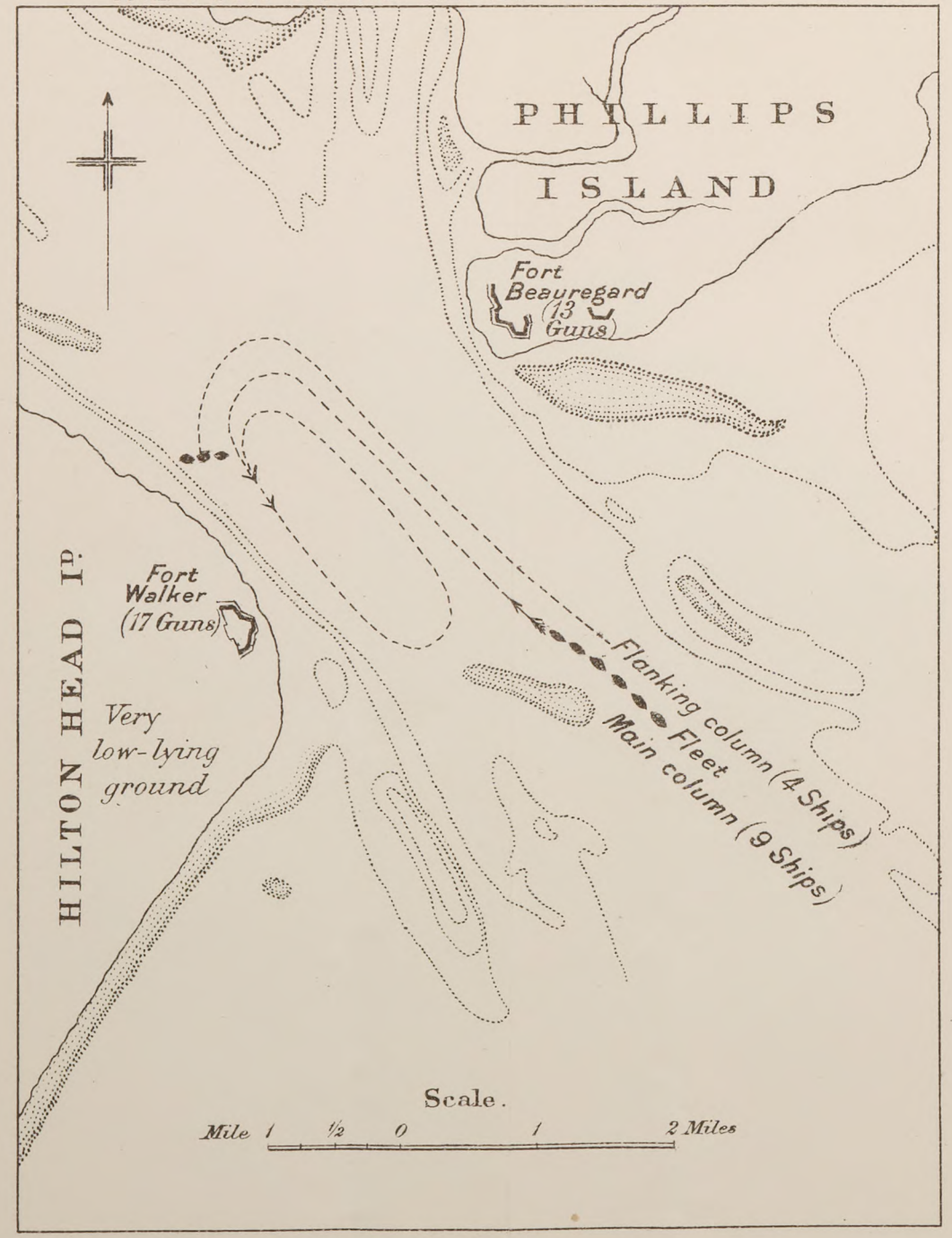
THE PORT ROYAL EXPEDITION 1861. PLATE V.



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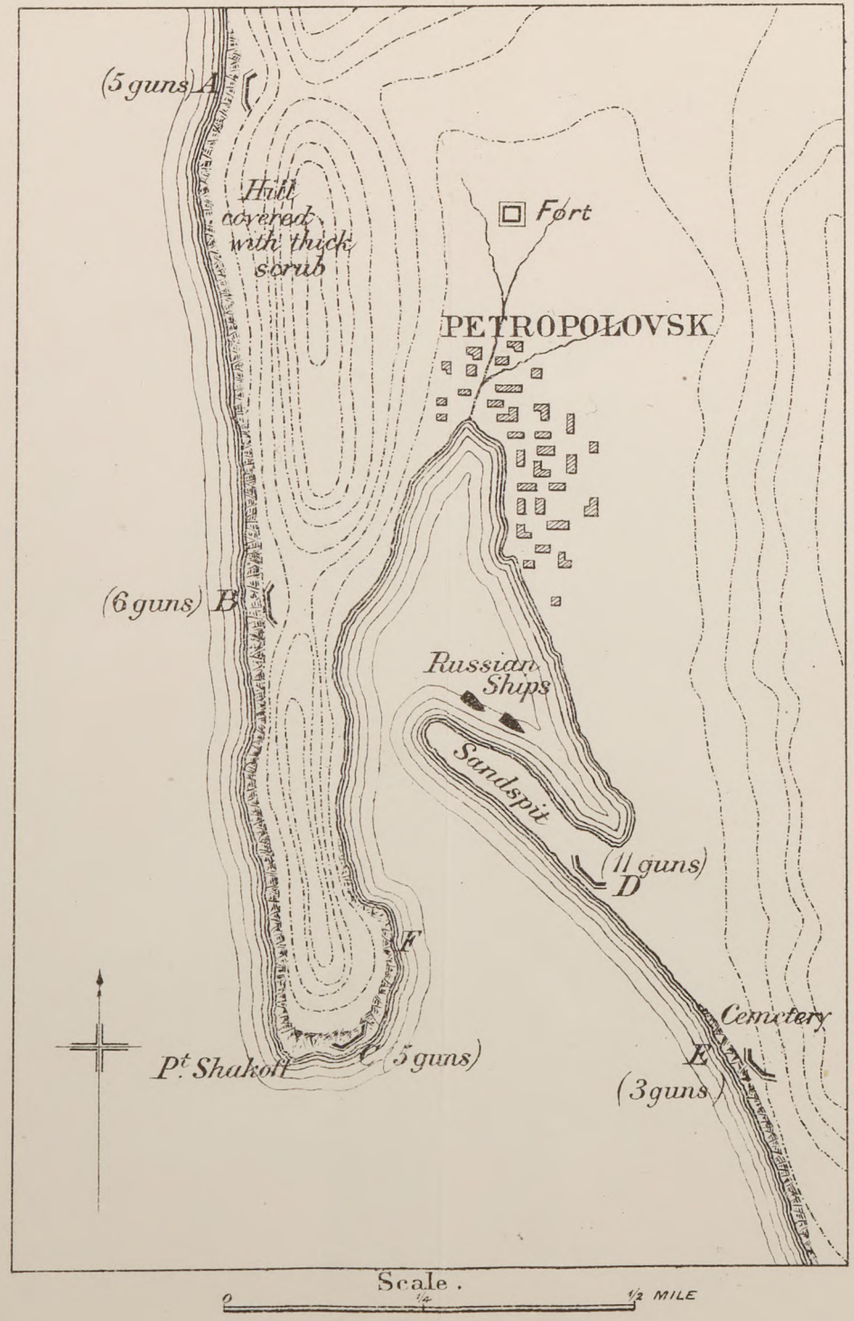
CRIMEAN WAR. PLATE VI.



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